Section 7

Description and Evaluation of Selected Plan

The previous section contained a description of the plan formulation rationale for the feasibility study. Planning objectives and constraints were established, viable solutions for providing successful passage over the Little Falls Dam for anadromous fish were identified, and design criteria and assumptions were assembled. With this information, alternative plans were formulated and a feasible alternative to solve the fish barrier problem was identified. This section provides an integrated evaluation of the environmental, economic, cultural, and social impacts for the recommended plan, the labyrinth weir notch.

7.1 PLAN DESCRIPTION

On completion of the detailed evaluation of the three viable alternatives, the determination was made that the labyrinth weir notch was the best solution to the fish barrier problem at the Little Falls Dam. In order to determine the benefits of the notch plan, the "without-project" plan must be identified and evaluated. The "with-project" plan was formulated and compared to the "without-project" plan to evaluate the project benefits and impacts.

7.1.1 Without-Project

The without-project plan represents the base from which all changes are measured. The future conditions at Little Falls Dam can be measured through environmental and economic changes.

7.1.1.a Future Environmental Conditions

The no-Federal-action "without-project" condition represents the base from which all changes are measured. The no-action alternative would abandon the project altogether. Under this scenario, no structure would be constructed to alleviate the fish barrier problem at the Little Falls Dam, and anadromous fish or resident species would not be able to utilize the 10 miles of suitable aquatic habitat above the dam.

7.1.1.b Future Economic Conditions

Without a project to alleviate the fish barrier problem resulting from the construction of the Little Falls Dam, economic losses will undoubtedly continue to occur. Fewer recreational fishermen would frequent this area. They would move downstream to fish further below the dam. Commercial fishermen would also be adversely affected, because the natural stocks of these anadromous species will continue to decline if they are restricted from using the established, highly productive habitat areas available above the Little Falls Dam.

7.1.2 With-Project Conditions

The with-project plan consists of a labyrinth weir notch fishway constructed approximately 60 feet from the Virginia shoreline, as discussed in Section 5. Prior to identifying the most feasible notch configuration, variations of the basic notch design were modeled to ensure that the notch option selected for the alternatives analysis met all the required criteria for the site.

In accordance with the hydraulic design and analysis performed in conjunction with this study, the following parameters were determined (see Annex A Hydrology and Hydraulics for a more detailed discussion). The notch will be 24 feet wide with the centerline 75 feet from the abutment at the Virginia shoreline. This distance from the shore places the notch far enough for the flow to clear the remaining concrete cap on the C&O Canal rubble dam, by avoiding any adverse impacts to the rubble dam.

7.1.2.a Structural Conditions

The existing dam is a non-reinforced gravity structure with three horizontal construction joints in its height. With a foundation keyed into bedrock to prevent undermining and scour, the existing dam has a high degree of stability with respect to slipping. After the notch is cut into the dam, the center of gravity of the section is lowered and the overturning moment arm is reduced.

To overcome any potential weakness in the residual dam sections adjacent to the notch, three rock anchors are placed on each side of the notch. These anchors will help protect against any seismic forces and from unusually large and unanticipated floating objects.

The notch will be cut down 4.4 feet to elevation 35.0 feet asl with a length of 28.5 feet and three labyrinth weirs (see Annex B Engineering Summary and Feasibility Design Plans). Since the grout bags are not considered structural concrete, they will be removed and replaced with a new concrete base attached to the ogee-section concrete. The weirs will be set onto this new concrete base to assure structural integrity. New concrete grout bags will be placed in front of the passage to maintain the 1:4 slope at the base of the dam.

7.1.2.b Hydraulic Conditions

The recommended alternative meets all of the hydraulic criteria with velocities within the acceptable limits for burst speeds (10-13 feet per second) for the desired anadromous species as determined by resource agencies and as agreed upon by the Little Falls Task Force (see Annex A, Hydraulics and Hydrology). It also provides relatively high downstream attraction velocities with low turbulence. This should enable fish searching along the dam, to locate and remain in the vicinity of the notch. There should not be any damage to the C&O Canal rubble dam just downstream of the proposed structure. Finally, at a pool water surface elevation of 39.4 feet above sea level, the notch is rated at 340 cfs, which will not affect the water supply minimum requirement of 250 million gallons per day (387 cfs).

7.2 ENVIRONMENTAL CONSEQUENCES

7.2.1 Biological Resources

The proposed modifications are expected to result in long-range, positive environmental influences. Various resources were reviewed and considered in the determination of environmental impacts. This information can be found in Annex C, Environmental Data.

7.2.1.a Terrestrial Resources

Temporary adverse impacts will occur to animal species by an increase in noise and human activity in the vicinity of the work area, and by a loss of cover and habitat. The existing construction areas, which were established for the grout bag placement project in 1985, will be used for staging areas and construction access, and are considered to be disturbed habitat areas. These areas will be graded, seeded, and allowed to revert to the pre-construction conditions after the proposed work is completed.

The expansion of the range of migratory fish will attract additional terrestrial species that depend on such fish, eggs, or larvae as additional food supplies.

7.2.1.b Wetlands

An examination of the wetlands resources by the Corps of Engineers determined that no wetland areas would be impacted in the project modification area. The passage of migratory fish would benefit upstream wetland areas by increasing the usage of wetlands for spawning and juvenile protection and feeding. The use of wetlands by migratory fish would increase the value of the system.

7.2.1.c Prime Farmlands

The site lacks farmland soil, and thus, there will be no impact to prime farmland soil. An existing access road will be used for construction equipment to access the site.

7.2.1.d Aquatic Resources

The project will improve access to additional spawning, rearing, and feeding habitat upstream of the Little Falls Dam for American shad, river herring, striped bass, and other anadromous species as well as resident species. Potential adverse impacts include temporary increases in suspended sediments during construction. An additional 380 square feet of river bottom will be covered with the replacement of the grout bags in front of the notch structure to assure that a vertical roller will not occur.

An evaluation of the impacts on waters of the United States was performed pursuant to the Environmental Protection Agency, Section 404 (b) (1) guidelines for the placement of fill materials

in waters of the United States. That evaluation is included in this report in Annex C, Environmental Data.

Turbidity will be increased temporarily in the immediate project area by equipment operation and gabion cage placement. In addition, a minimal amount of sediment now deposited behind the dam is expected to move downstream when the notch structure is being constructed. Sediment movement is expected to be minimal. Sediment and erosion control methods will be employed in compliance with local, state, and Federal Laws.

Finfish will be disturbed temporarily by the noise and activity in the river. Potential adverse effects on finfish will be minimized by scheduling the project during the period of least biological sensitivity. Finfish will relocate to preferred water depths, and benthic communities will recolonize when construction structures are removed. The project will be constructed between September 1 and February 28 to avoid disturbance to anadromous fish during spawning.

Beneficial impacts from the proposed work will be the reintroduction of migratory fish to the higher quality spawning, rearing, and feeding habitat in the upstream reaches. The project will allow access to the approximately 1,000 acres of available habitat for anadromous fish within the 10-mile stretch of the Potomac River above the Little Falls Dam. By re-establishing the passage for upstream migration of anadromous fish to these spawning areas, it is anticipated that approximately 50,000 American shad can be supported in this area as well as approximately 250,000 river herring. Other anadromous species as well as resident species are expected to use the river above the dam once the barrier is removed. The amount of river herring using this historic habitat will determine the amount of striped bass attracted to the area for feeding and resting. It is anticipated that approximately 50,000 striped bass will ascend to these areas once suitable passage is provided.

The passage of migratory fish to an additional 10 miles of aquatic habitat will add to the diversity of the biota in the upstream habitat, support the food web, and serve as an important link to other piscivores and to some mammals, amphibians, invertebrates, waterfowl, and predatory species.

7.2.2 Air Quality

The project was evaluated to determine whether the Clean Air Act Conformity Regulations apply to this project (58 *Federal Register* 63214, November 30, 1993). The project is exempt from this regulation as stated in 40 CFR Section 93.153(c)(1). Impacts on air quality would be temporary. Fugitive dust may be released during construction activities at the temporary staging areas. A temporary increase in emissions of volatile organic compounds, nitrogen oxides, sulfer dioxide, and carbon monoxide from construction vehicles (mobile sources) will occur. Emissions produced during construction are not expected to exceed ambient air quality standards for the area. Temporary construction activities are generally accounted for in the Maryland State Implementation Plan.

7.2.3 Cultural Resources

The Corps provided an assessment of effects of this project to the Maryland Historical Trust (MHT) on March 8, 1996. In a letter dated April 12, 1996, MHT concurred that there will be no adverse impacts to the water supply requirements of the C&O Canal or to the C&O Canal rubble dam. There are no known archeological sites within the study area. The proposed construction is to modify an existing structure and will have minimal impacts to areas that have not been previously disturbed.

7.2.4 Aesthetics and Recreational Resources

It is anticipated that construction will last approximately 6 months. During construction activities, there will be disturbances to the recreational use of the C&O Canal Park by the continuous flow of concrete trucks, and materials will cause interruptions to the passers-by. Such items as dust abatement, security fences, and spectator protection will be used to maintain the recreational amenities of the park and to protect visitors. The contractor will provide whatever precautions are necessary to protect the parklands and visitors.

7.2.5 Hydrology and Water Quality

Turbidity produced by the construction and placement of the fish passage and new grout bags is expected to be minimal and will be restricted to the portion of the river where the fish passage will be located. The effects of turbidity are expected to be temporary and limited and will have only a minor adverse impact to water quality and the aquatic ecosystem. Use of best management practices (BMP's), designated through the Nationwide Permit Program, will minimize turbidity created by the project. A copy of the BMP's is included in Annex C, Environmental Data.

Once completed, the notch will allow the restoration of water circulation patterns comparable to conditions similar to those that existed prior to construction. The downstream movement of water in this section of the dam will increase slightly due to the lower dam elevation at the fish passage. This will also create better flushing directly below the dam and in the immediate downstream area.

7.2.6 Threatened and Endangered Species

In compliance with Section 7 of the Endangered and Threatened Species Act, the Corps of Engineers has coordinated the proposed project activities with the USFWS. The USFWS determined that, except for occasional transient individuals, no federally listed or proposed threatened or endangered species are known to presently inhabit the area. There are no known state listed threatened or endangered species inhabiting the affected project area.

7.2.7 Environmental Justice

This project is expected to comply with Executive Order 12989 - Environmental Justice in

Minority Populations and Low-Income Populations, dated February 11, 1994. The project is not located in close proximity to a minority or low-income community, and no impacts are expected to occur to any minority or low-income communities in the area.

7.2.8 Hazardous, Toxic, and Radioactive Waste

No evidence of hazardous, toxic, or radioactive material that has the potential to contaminate the groundwater, surface water, or soils in the project vicinity has been found, nor is there any reason to suspect its presence.

7.2.9 Cumulative Impacts

Cumulative impacts are assessed by evaluating the incremental effects of past, present, and future actions. Cumulative impacts relevant for consideration include the protection and enhancement of the abundance and variety of wildlife species in the Potomac and in the Chesapeake Bay, and the recreational and educational opportunities generated by increasing the numbers and the range of valued migratory fish species.

Restoration to the passage of anadromous fish populations to the habitat above Little Falls Dam, in conjunction with the ICPRB/USFWS stocking and monitoring projects and local stream clean-up efforts within the Potomac River, is projected to have a long-term positive influence on the Chesapeake Bay ecosystem. This project will provide spawning, rearing, feeding, and resting habitat for fish and wildlife and will support the food web. The notch will assist in recovering some of the ecosystem functions that have been degraded by the construction of the Little Falls Dam and the failed fishway at Snake Island. The detrimental effects to the recreational and economic opportunities within the study area, due to the fish barrier, will be alleviated with the construction of the notch. It is anticipated that the passage will encourage the abundance and diversity of fish and wildlife in the study area, resulting in long-term benefits to the diversity and strength of the ecosystem, providing greater environmental, recreational, aesthetic, and economic value to this area.

The beneficial cumulative impacts have also been stated in the goals of the Little Falls Task Force Memorandum of Agreement (MOA). The MOA, which is included in Annex E, Correspondence and Coordination, represents a cooperative agreement among the Corps of Engineers, U.S. Fish and Wildlife Service, Interstate Commission on the Potomac River Basin, U.S. Environmental Protection Agency, National Marine Fisheries Service, National Park Service, National Biological Service, National Fish and Wildlife Foundation, Maryland Department of Natural Resources, Virginia Department of Game and Inland Fisheries, the District of Columbia Environmental Regulatory Administration, Montgomery County Government and the Potomac River Fisheries Commission to reestablish migratory and anadromous fish access and to restore a migratory fish population in a historic spawning habitat upstream of the Little Falls Dam.

7.2.10 Compliance With Environmental Statutes

In addition to the environmental impacts discussed in this report, a review of the proposed actions have been made with regard to other potential areas of concern. An evaluation of the impacts of the proposed project on waters of the United States was performed pursuant to the guidelines promulgated by the administrator of the U.S. Environmental Protection Agency, under authority of Section 404 of the Clean Water Act, due to the predicted minor impact of 385 square feet of shallow water habitat from the grout bag replacement. A report of that evaluation is included in this report in Appendix C, Environmental Data. The proposed modification action conforms to the conditions of the Nationwide Permits (NWPs): NWP #3 - Maintenance, and NWP #25 - Structural Discharge. The State of Maryland has already issued Water Quality Certification for these NWPs. The State of Maryland, Department of the Environment (MDE) has reviewed the 404 (b) (1) evaluation and factsheet of the proposed action, and concurs that a general water quality certification is issued for these NWP's. A copy of MDE's letter and a summary of compliance with various environmental statutes and other environmental review requirements can be found in Annex C Environmental Data.

7.2.11 Coordination

In compliance with NEPA and the Clean Water Act, the proposed project has been coordinated with other concerned resource agencies, including the U.S. Fish and Wildlife Service, Interstate Commission on the Potomac River Basin, U.S. Environmental Protection Agency, National Marine Fisheries Service, National Park Service, National Biological Service, National Fish and Wildlife Foundation, Maryland Department of Natural Resources, Virginia Department of Game and Inland Fisheries, the District of Columbia Environmental Regulatory Administration, and the Potomac River Fisheries Commission. Copies of the correspondence with these agencies can be found in Annex E. A Public Notice describing the proposed activities has been distributed to the public for review, and comments have been addressed and incorporated into the PMR.

7.2.12 Real Estate Requirements

Construction of the recommended plan will require permits from the National Parks Service for a temporary construction access and staging area. There is currently access down to the Virginia shoreline for dam maintenance. This "right-of-necessity" can be used to gain access to the proposed structure for any maintenance. The labyrinth weir notch design is anticipated to require minimal maintenance. The Real Estate Plan, a map of the required lands, and a cost estimate are provided in Annex F.

7.2.13 Conclusions

An overall positive environmental influence with no significant adverse impacts is anticipated with the proposed action. Based on the responses to the Public Notice and coordination with the Little Falls Task Force, the various resource agencies and the Corps do not anticipate any significant adverse environmental impacts associated with the proposed action. Alternatives to the proposed

action have been described and evaluated in this report. Therefore, it has been determined that the preparation of an environmental impact statement is not warranted. The District has prepared a Finding of No Significant Impact (FONSI) which is provided at the end of Section 10 of this report.

Section 8

Non-Federal Responsibilities

8.1 COST ALLOCATION AND APPORTIONMENT

A non-Federal sponsor is required to provide at least 25 percent of the implementation costs of the modification. Implementation costs include preparation of this report, preparation of the project plans and specifications, and construction of the modification. The provision of work in-kind can be credited against the sponsor's cost-sharing requirement as specified under EC 1105-2-206, paragraph 6, which states, "Work in-kind will be credited to the non-Federal sponsor's share of the total project modification costs within the following limits...Work in-kind may be accepted as long as it does not result in any reimbursement of the non-Federal sponsor. The work in-kind, when combined with the non-Federal provisions of LERRD, cannot exceed 25 percent of project costs." Maryland Department of Natural Resources is the sponsor for this modification and will be funding this project through Maryland Department of Natural Resources mitigation funds.

In the event that the recommended modifications are approved, the non-Federal interests would be required to do the following:

a. Provide without cost to the United States all necessary land, easements, and rights-of-way, access routes, and relocations of utilities necessary for project construction and subsequent operation and maintenance.

b. Provide, during the period of implementation, a cash contribution in the amount necessary to make its total contribution equal to 25 percent, currently estimated to be $286,250, if the value of such lands, easements, rights-of-way, and relocations (LERRD) represents less than 25 percent of the total project modification costs,

c. Assure maintenance and repair during the useful life of the work as required to serve the project's intended purpose, except for the repair, replacement, or rehabilitation of the Little Falls Dam.

d. Provide the presently estimated non-Federal share of the total first cost of the recommended project amounting to $286,250, equivalent to 25 percent of the costs to conduct a feasibility study, prepare detailed plans and specifications, and construct the modification.

e. Hold and save the United States free from claims for damages which may result from construction and subsequent maintenance of the project, except damages due to the fault or negligence of the United States or its contractor.

f. Comply with applicable provisions of the Uniformed Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) and implementing regulations.

g. Execute the Assurance of Compliance pertaining to Title IV of the Civil Rights Act of 1964 (Public Law 88-352, 78 Stat. 241, 252).

8.2 FINANCIAL ANALYSIS

Maryland Department of Natural Resources, the non-Federal sponsor, is willing and able to share the costs of the project implementation. For the Little Falls Fish Passage Modification project, the non-Federal share of the construction costs is currently estimated to be $286,250, which includes $15,000 for LERRD. MD DNR has budgeted to fund the non-Federal share of the project costs.

A letter of intent from the local sponsor to sign the project cooperation agreement (PCA) has been received by the Corps of Engineers and is located in Annex D.

The total project costs for the recommended modification, which includes costs for preparation of this report, preparation of the plans and specifications, construction of the project, and monitoring for up to 6 years, is estimated to be approximately $1.15 million. Of this total, 75 percent ($858,750) will be Federally funded, and 25 percent ($286,250) will be funded by the non-Federal sponsor. A summary of the costs is shown in Table 8.1. A 15-percent contingency has been included as well as an escalation factor of 2 percent to allow for future cost increases. A detailed cost estimate for the project is contained in Annex B. The estimates are based on April 1996 price levels.

Table 8.1

Cost Apportionment

Phase	Total Cost
Feasibility Study	$200,000
Plans and Specifications*	$128,000
Construction	$685,000
Fish Stocking/Monitoring Project**	$60,000
Construction Management	$57,000
LERRD	$15,000
Total Project Costs	***$1,145,000***

Notes:

* The cost of Plans and Specifications is initially Federally-funded and distributed as a portion of the local share of project costs during construction.

** The costs for the fish monitoring program will be considered part of the project costs if the non-Federal sponsor, Maryland Department of Natural Resources, has the funds available at the time of the stocking/monitoring program initiation.

Section 9

SCHEDULE FOR ACCOMPLISHMENTS

A projected schedule has been developed based on the assumption that Federal and non-Federal funds will be available. The tentative schedule for project completion is as follows:

Submit Feasibility Report to HQUSACE	APR 1996
Obtain Project Approval	MAY 1996
Initiate Plans and Specifications	JUN 1996
Sign Final Project Cooperation Agreement	OCT 1996
Advertise Construction Contract	JAN 1997
Initiate Construction	SEP 1997
Complete Construction	MAR 1998

Section 10

FINDINGS, CONCLUSIONS, AND RECOMMENDATION

10.1 FINDINGS AND CONCLUSIONS

This Project Modification Report documents the damages sustained by the aquatic environment in this stretch of the Potomac River as a result of the placement of the Little Falls Dam and the failure of the fishway at Snake Island. As a result of the fish barrier, the declining diversity of the aquatic environment has adversely impacted the integrity of the ecosystem.

Based on technical analyses and economic studies, it was determined that the Labyrinth Weir Notch will provide fish passage at an economically feasible cost. The notch will provide passage to 3,017,000 Units of Fish at an average annual cost of $75,770. The local sponsor, MD DNR, fully supports the conclusions presented in this report and has signed a letter of intent to cost-share in the construction of the project. MD DNR will be required to pay 25 percent of the total project costs, currently estimated to be $286,250.

NEPA documentation required for implementation of the proposed actions, in the form of an integrated Environmental Assessment (EA) and a Finding of No Significant Impacts (FONSI), is included in this report. The requirements of the Clean Water Act Section 404(b)(1) have been met.

10.2 RECOMMENDATION

I recommend that the fish passage modification described in this report be approved and implemented. In my judgement, the proposed project is a justifiable expenditure of Federal funds. The total estimated construction cost of the project is $1.15 million of which $858,750 would be the Federal cost and $286,250 would be provided by Maryland Department of Natural Resources.

Randall R. Inouye, P.E.
Colonel, Corps of Engineers
District Engineer

FINDING OF NO SIGNIFICANT IMPACT

Environmental Assessment
Modifications for Fish Passage
Little Falls Dam
Potomac River
Montgomery County, Maryland

The Baltimore District, U.S. Army Corps of Engineers, proposes construction to improve fish passage through the Little Falls Dam, located in Montgomery County, Maryland. The existing dam, which the Washington Aqueduct uses in supplying water to the Washington, D.C., vicinity, acts as a barrier to anadromous fish attempting to migrate upstream. The modification proposed is designed to improve conditions for the passage of anadromous and resident fish species, without significantly reducing the effectiveness of the existing water supply project.

The modification to the Little Falls Dam includes the construction of a notch fishway with three labyrinth weirs to allow fish passage over the dam. The existing grout bags in this portion of the dam will be removed for the fishway construction and replaced with new grout bags after the passage has been placed.

An Environmental Assessment has been prepared that evaluates the potential environmental impacts associated with the proposed project. Potential impacts were assessed with regard to the physical, chemical, and biological characteristics of the aquatic and terrestrial environments; endangered and threatened species; hazardous, radioactive, and toxic materials; aesthetics and recreational resources; cultural resources; and the general needs and welfare of the public.

In compliance with the National Environmental Policy Act of 1969 (NEPA) and the Clean Water ACT OF 1977 (CWA), the proposed project has been coordinated with other concerned resource agencies. Comments received in response to these coordinations and other communications are included in the Integrated Environmental Assessment. A review of the proposed project in accordance with the CWA indicates that the project complies with the U.S. Environmental Protection Agency guidelines for discharge of dredged or fill material. The State of Maryland has granted a general water quality certification for the proposed action.

Upon reviewing the attached Environmental Assessment, I find that there will be significant beneficial effects with no significant adverse effects associated with implementation of the proposed project, and that no Environmental Impact Statement is required.

29 April 1996
Date

Randall R. Inouye, P.E.
Colonel, Corps of Engineers
Baltimore District Engineer

REFERENCES

Black and Veatch, Raw Water Supply, Little Falls Project, Preliminary Design Studies, Washington Aqueduct, U. S. Army Corps of Engineers, Kansas City, Missouri, 1953

Chesapeake Bay Program Living Resources Subcommittee Fish Passage Workgroup: Anadromous Fish Habitat Restoration: A Resource Assessment and Fish Passage Funding Proposal. Maryland Department of Natural Resources, Annapolis, Maryland, 1992.

Clay, P. Eng., Charles H., Design of Fishways and Other Fish Facilities, Lewis Publishers, Boca Raton, Florida, 1984.

Dalley, P.J., Investigation of Snake Island Fishway at Little Falls Dam, Potomac River, Maryland-Virginia, U.S. Fish and Wildlife Service, Region 5, August 1980.

Department of Environmental Programs Metropolitan Washington Council of Governments/Water Resources, Potomac River Water Quality 1982-1986: Trends and Issues in the Metropolitan Area. Washington, D.C., 1989.

Historic Document: A Potomac River Shad Fishery, 1814-1824.

ICPRB, FY 1996 Scope of Work for the Monitoring of Migratory Fish Passage and the Restoration of American Shad at the Little Falls Dam, Potomac River, ICPRB, Rockville, Maryland, 1996.

ICPRB, Potomac Basin Reporter, Vol.50, No.6, ICPRB, Rockville, Maryland, August 1994.

ICPRB, Potomac Basin Reporter, Vol.51, No.3, ICPRB, Rockville, Maryland, May/June 1995.

Maryland Department of Natural Resources, Potomac River Environmental Flow-By Study, Department of Natural Resources, Annapolis, Maryland 1981.

Maryland Fish Passage Conference, Baltimore, Maryland, November 16-18, 1994.

Nichols, Paul, Passage Conditions and Counts of Fish at the Snake Island Fishway, Little Falls Dam, Potomac River, Maryland, 1960-1963, U.S. Department of the Interior, Fish and Wildlife Service, Washington D.C., February 1968.

Odeh, Mufeed, John Noreika, and Alexander Haro, Hrdraulic Model Study of Little Falls Dam Fish Passage, S.O. Conte Anadromous Fish Research Center, Turners Falls, Mass., June 1995.

O'Dell, Jay, Fish Passage Development, Little Falls Dam(s) Potomac River: Historic Biological and Fish Passage Information and Alternatives, Maryland Department of Natural Resources, Annapolis, Maryland, July 1992.

O'Dell, Jay, Implementation Plan for Removing Impediments to Migratory Fishes in the Chesapeake Bay Watershed, Maryland Department of Natural Resources, CBP/APR 108/93, Jan 1992.

Odom, Michael C., A Strategic Plan for the Restoration of Amaerican Shad to the Potomac River Upstream of Little Falls Dam , U.S. Fish and Wildlife Service, Charles City, Virginia, May 1995.

U.S. Army Corps of Engineers, Institute for Water Resources. 1994. Cost Effectiveness for Environmental Planning: Nine Easy Steps. IWR Report 94-PS-2, October 1994.

U.S. Army Corps of Engineers, Institute for Water Resources. 1994. Evaluation of Environmental Investments Procedures Manual. Interim: Cost Effectiveness and Incremental Cost Analyses. IWR Report 95-R-1, May 1995

U. S. Army Corps of Engineers, Fish Passage Development and Evaluation Program. 1991. Fisheries Handbook of Engineering Requirements and Biological Criteria. Oregon, 1990.

U. S. Army Corps of Engineers, Little Falls Raw Water Supply, Washington D.C. 1959.

U.S. Army Corps of Engineers, Washington Aqueducts Little Falls Project: Design Memorandum: Snake Island Fishway, Corps of Engineers, Washington D.C., March 1957.

U.S. Commission of Fish and Fisheries, Report of the Commissioner, Government Printing Office, Washington D.C., 1886.

U. S. Department of Commerce, 1990 Census of Population, Social and Economic Characteristics, CP-2-22, Maryland, 1990.

US Army Corps
of Engineers
Baltimore District

ANNEX A

HYDRAULICS AND HYDROLOGY

LITTLE FALLS DAM
FISH PASSAGE MODIFICATION

APRIL 1996

Annex A

Hydraulics and Hydrology

Table of Contents

ANNEX A-1

Little Falls Dam Fish Passage
Potomac River
Montgomery County, MD and Fairfax County, VA
Behavior of Proposed Modification

1. Purpose

The H&H Section of the Baltimore District of the U.S. Army Corps of Engineers has been tasked with assessing the impact of the proposed (modification #7) fish passage structure on the Washington Aqueduct Division (WAD) pumping station intake and on the C&O Canal. The H&H Section has also been tasked with estimating the duration of time that 12 inches of water will be maintained over the fish passage structure during the target fish passage months.

2. Background

Little Falls Dam is located on the Potomac River between Maryland and Virginia approximately one mile upstream of the Maryland-District of Columbia line. An area map is shown in Figure 1. The dam is approximately 1,400 feet long and is used to provide water to a WAD pumping station. A historic rubble dam is located approximately 50 feet below Little Falls Dam. The proposed fish passage structure is intended to reestablish migratory fish access to ten miles of historic spawning habitat upstream of the dam to Great Falls.

3. WAD Pump Station Intake

Flow exceedence curves are used to assess the impact of the proposed fish passage structure. The annual percent exceedance of flows on the Potomac River at Little Falls Dam is shown in Figure 2. The curve takes into consideration the Interstate Commission on the Potomac River Basin Water Agreement. This agreement has established that a minimum discharge of 300 MGD (464 cfs) is to be released from Great Falls. As a result of this agreement, flow into the pool behind the Little Falls Dam will exceed 300 MGD for 100% of the year. The elevation of the crest of the lowest part of the current dam is 39.0 feet (WAD datum), while the invert of the proposed fish passage structure is at 37.0 feet (WAD datum). This lower invert elevation for the proposed conditions results in a lower rating curve (Little Falls pool elevation versus flow) for Little Falls Dam, thus causing a lower pool for a given percent exceedance.

The intake for the WAD Little Falls pump station is located immediately upstream of the Little Falls Dam. The pump station is typically used during the summer and can be called upon to withdraw a maximum of 250 MGD (386 cfs) from the Potomac River. The water agreement has established that a minimum of 100 MGD (154 cfs) is to be passed through Little Falls Dam. During the times that the 300 MGD (464 cfs) released through Great Falls is the only flow that is entering the pool behind Little Falls Dam, the maximum flow that can be withdrawn by the pump station is 200 MGD (309 cfs). Therefore, during droughts, the minimum elevation in the pool will be determined by the remaining flow resulting from 300 MGD minus any amount that is withdrawn by the pump station.

Based upon data from WAD, it has been determined that a minimum pool elevation of 38.40 feet (WAD datum) is required to maintain sufficient head for the pump station. There is insufficient information available to

determine if this elevation must be maintained while the pumps are in operation, so both with and without pumping conditions have been assessed.

The percent of the time that the pool level above Little Falls Dam is exceeded for current and proposed conditions is shown in Figure 3 when the pumps are not in operation and in Figure 4 when the pumps are in operation. These figures show that the proposed fish passage structure will reduce the upstream pool by approximately 0.1 feet for most flows. As illustrated in Figure 3, the pool elevation is maintained well above the minimum head for the WAD pump station when the pumps are not in operation. When the WAD pump station withdraws 250 MGD (386 cfs), the pool is lowered. The affects are greater during the higher exceedance values when the pump station is withdrawing a greater fraction of the water entering the pool. Nevertheless, as illustrated in Figure 4, the minimum pool required for operation of the pump station is maintained during pump withdrawal. Therefore, as long as Great Falls provides 300 MGD (464 cfs) to the Little Falls pool, the proposed fish passage structure will not cause the pool to drop below the elevation required by the WAD pump station.

4. C&O Canal

The crest elevation of the current Little Falls Dam is 0.4 feet higher on the Virginia side of Snake Island than on the Maryland side. This condition diverts water into an area adjacent to the C&O Canal between Little Falls Dam and the downstream rubble dam during low flow conditions. This area extends on the Maryland side of High Island for approximately 3,000 feet. Water is diverted through a sluice gate into the C&O Canal from this area.

The Interstate Commission on the Potomac River Basin Water Agreement specifies that a minimum of 100 MGD (154 cfs) is to be passed over Little Falls Dam. The current conditions at Little Falls Dam results in all of this minimal flow passing over the Maryland side of Snake Island. Since the invert of the proposed fish passage structure (37.0 feet, WAD datum) is lower than the crest of the Maryland side of Little Falls Dam (39.0 feet, WAD datum) and is located on the Virginia side of Snake Island, the proposed conditions will result in less discharge flowing over the dam on the Maryland side of Snake Island at a given percent exceedance. This difference is illustrated in Figure 5 when the pumps are not in operation and in Figure 6 when the pumps are in operation. The flow duration analysis illustrated in Figure 5 indicates that, if the pumps are not in operation and a minimum of 300 MGD (464 cfs) is released through Great Falls, a minimum of 100 MGD will pass over the Maryland side of Little Falls Dam. However, as illustrated in Figure 6, pump withdrawal during low stream flows can result in all of the remaining flow passing through the fish passage structure. This analysis indicates that less than 100 MGD will flow into the Maryland side for approximately 1.7% of an average year and that zero discharge will flow into the Maryland side for approximately 0.6% of an average year. Therefore, for approximately 2 days out of a typical year, either pumping will have to be curtailed or the discharge over the dam on the Maryland side of Snake Island would have to be allowed to drop to zero.

It must be kept in mind that the upper limits of a flow duration analysis are extremely sensitive to outliers (extreme drought events). Therefore, the small percentages indicated by the flow duration analysis should only be taken as relative amounts. The actual number of days when pumping could result in zero flow through the Maryland side will vary considerably from year to year. The impact on fish and aquatic fauna in this area and the C&O Canal will be dependent on the duration of this zero flow period. Nevertheless, during rare drought events, the withdrawal from the WAD pump station will be limited to 50

MGD (77 cfs) if 100 MGD flow is to be maintained over the dam on the Maryland side of Snake Island. Therefore, the pumps cannot be operated at their maximum capacity during periods when the only water that enters the Little Falls pool is the 300 MGD from Great Falls.

5. Minimum Flow Depth

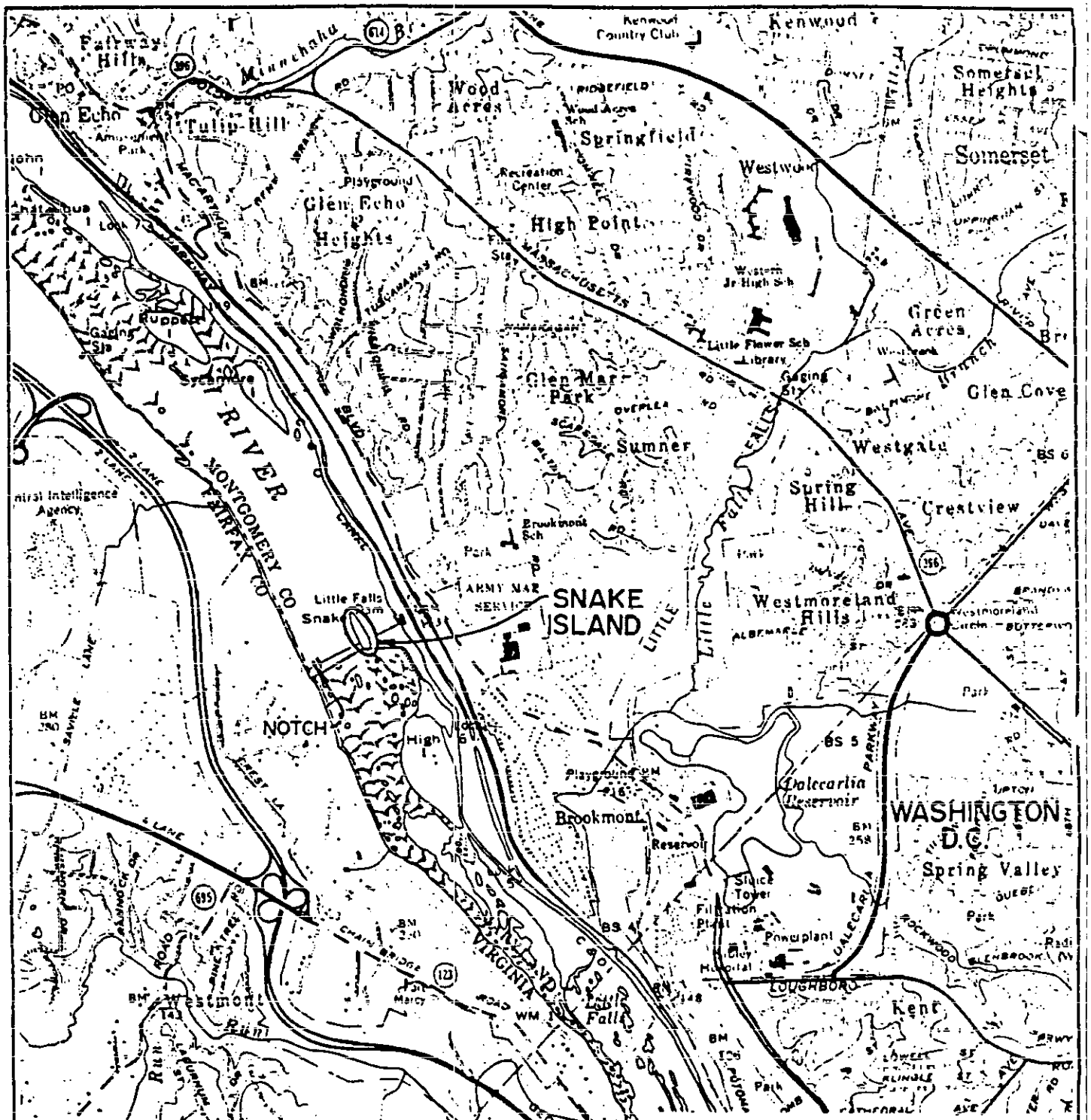
A minimum 12 inch depth of flow is necessary for the target species of fish to utilize the fish passage structure. This requirement has been assessed with the flow exceedance curves that have been developed for the target fish passage months of March, April, and May (Figure 7). A significant amount of the annual precipitation occurs in these months. Thus, for a given percent exceedance, the flows are larger than they are on an annual basis.

The S. O. Conte Anadromous Fish Research Center model test of the proposed fish passage structure determined that the minimum water depth should be approximately 3.2 feet for a river flow of 3,231 MGD (5,000 cfs). As illustrated in Figure 7, the Potomac River at Little Falls will exceed this flow for approximately 95% of the time for the projected fish passage months.

However, this is not to say that the target fish species will be able to pass through the proposed fish passage structure at all times since the magnitude of the flow velocities at different flow levels may be greater than the darting speeds of some of the target species. In addition, some target species may not be able to maintain the necessary speed to cross the entire length of the fish passage structure at some flow levels.

6. Conclusion

According to the operational criteria provided to H&H, the proposed fish passage structure will have no affect on the minimum pool elevation required for the WAD pump station intake. However, the pump station withdrawal will have to be limited to 50 MGD (77 cfs) during rare drought events if the C&O Canal in the Little Falls area is not to be impacted. The minimum 12 inch flow depth through the fish passage structure should be maintained during the target fish passage months.



REV	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BALTIMORE
CORPS OF ENGINEERS
BALTIMORE, MARYLAND

POTOMAC RIVER — VIRGINIA SIDE

LITTLE FALLS FISH PASSAGE
FIGURE 1
LOCATION MAP

BEAVIN COMPANY ENGINEERS-SURVEYORS BALTIMORE, MD	DRAWING NUMBER	PLATE
SCALE: 1"=2000'	DATE: 10/18/95	SHEET of

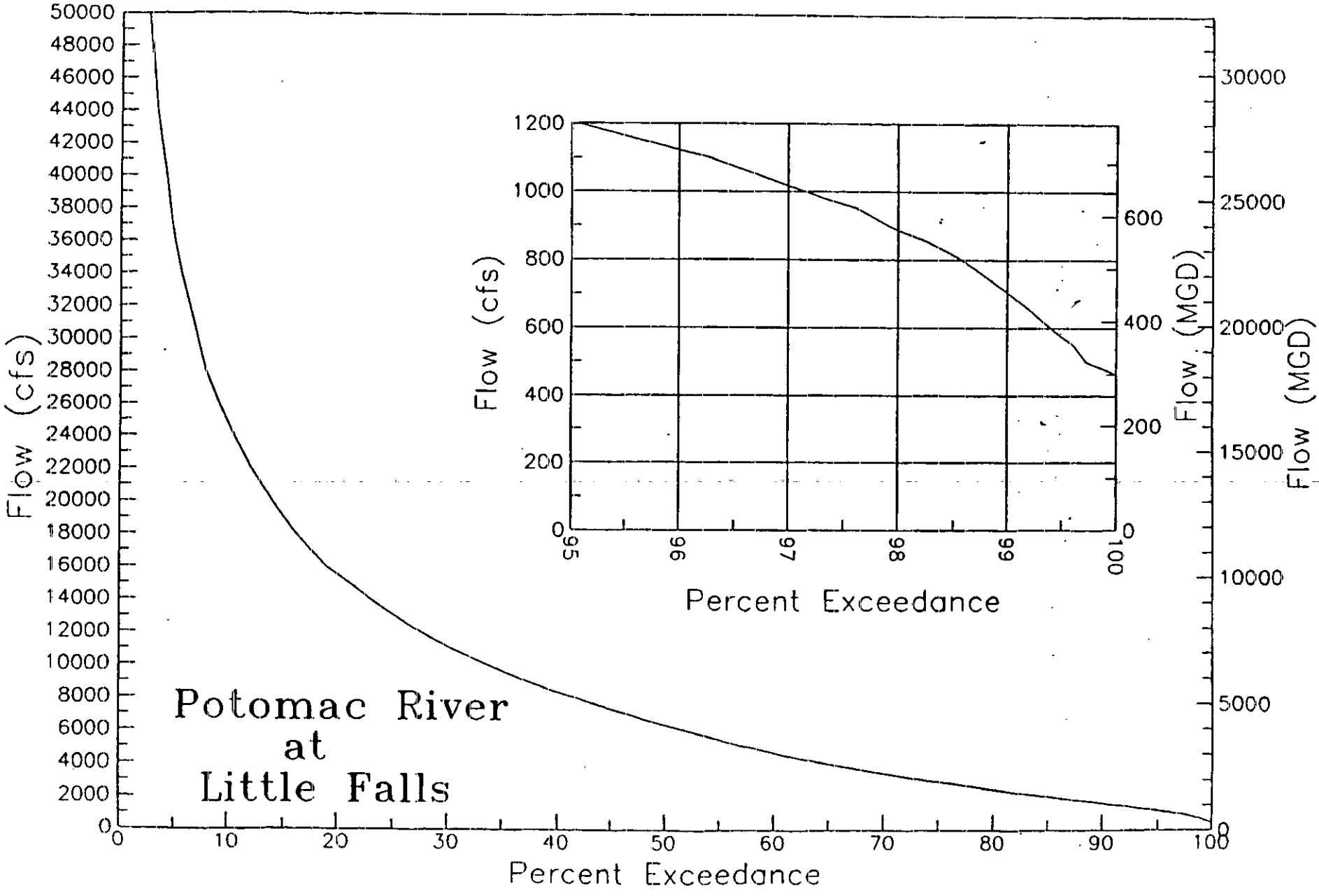

Flow (cfs)
50000
48000
46000
44000
42000
40000
38000
36000
34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Flow (MGD)
30000
25000
20000
15000
10000
5000
0
0
10
20
30
40
50
60
70
80
90
100
Percent Exceedance
Potomac River
at
Little Falls
Flow (cfs)
1200
1000
800
600
400
200
0
Flow (MGD)
600
400
200
0
95
96
97
98
99
100
Percent Exceedance

Figure 2

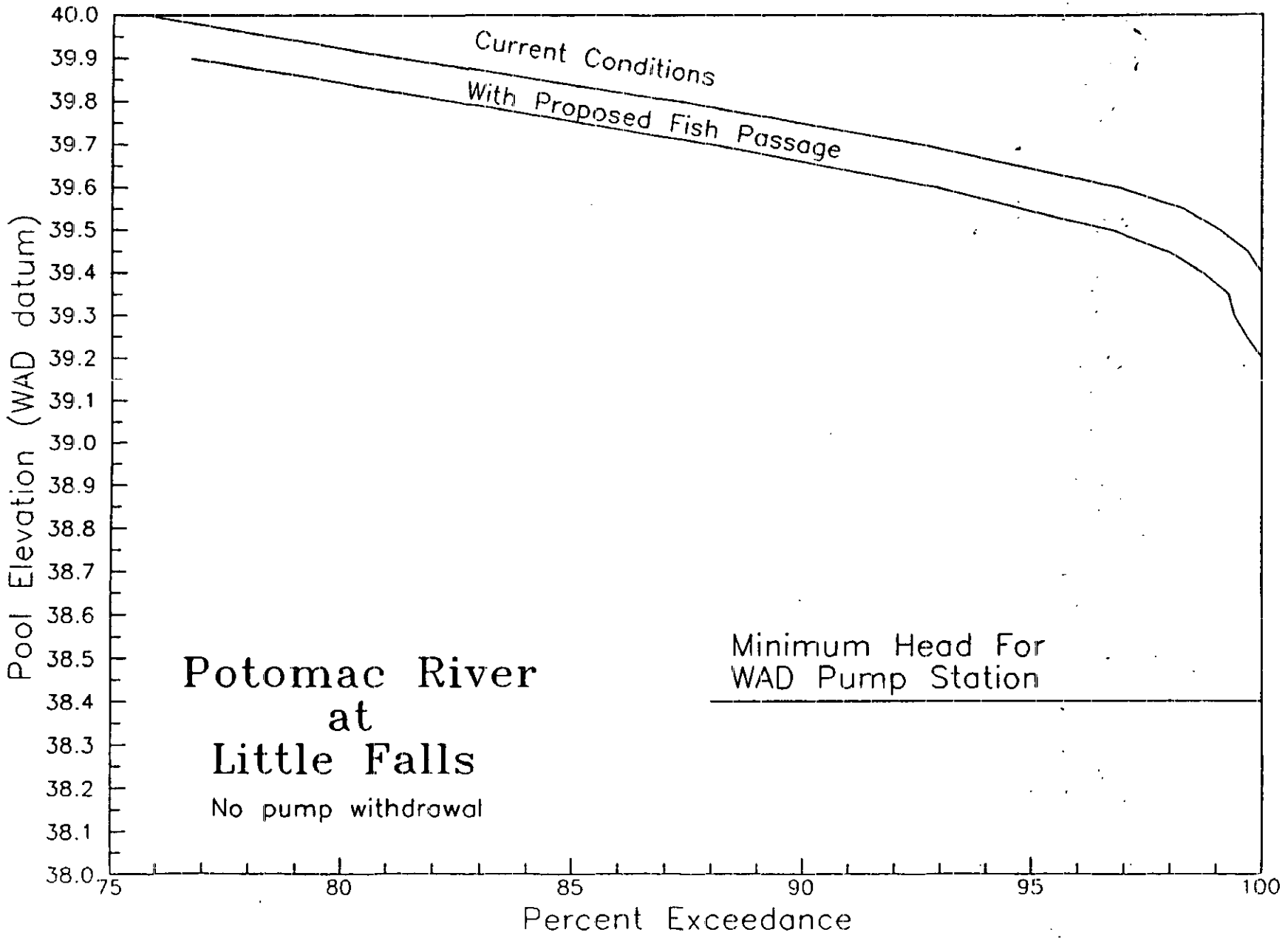

Current Conditions
With Proposed Fish Passage
Minimum Head For
WAD Pump Station
Potomac River
at
Little Falls
No pump withdrawal
Pool Elevation (WAD datum)
Percent Exceedance
40.0
39.9
39.8
39.7
39.6
39.5
39.4
39.3
39.2
39.1
39.0
38.9
38.8
38.7
38.6
38.5
38.4
38.3
38.2
38.1
38.0
75
80
85
90
95
100

Figure 3

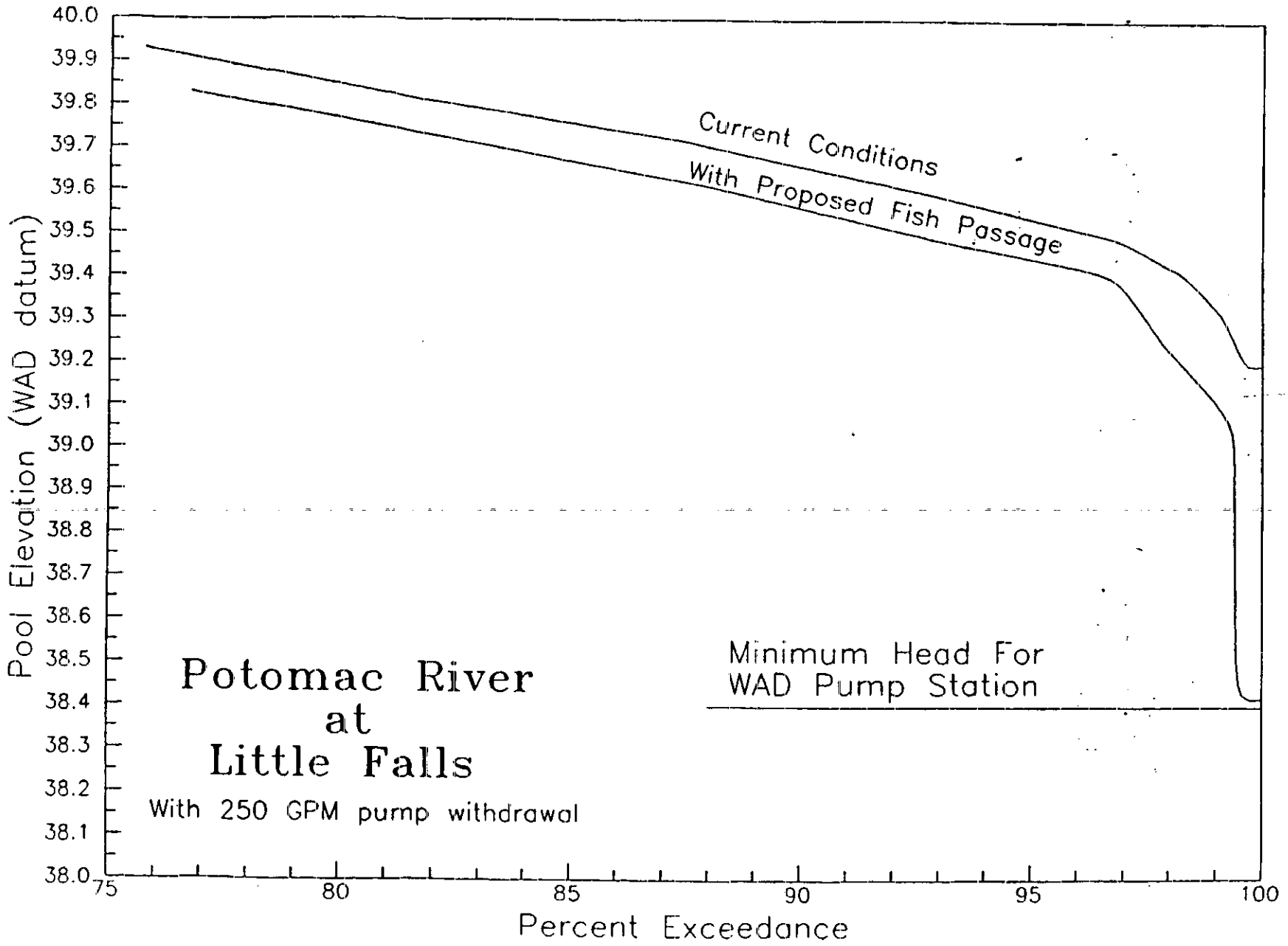

Pool Elevation (WAD datum)
40.0
39.9
39.8
39.7
39.6
39.5
39.4
39.3
39.2
39.1
39.0
38.9
38.8
38.7
38.6
38.5
38.4
38.3
38.2
38.1
38.0
75
80
85
90
95
100
Percent Exceedance
Current Conditions
With Proposed Fish Passage
Minimum Head For
WAD Pump Station
Potomac River
at
Little Falls
With 250 GPM pump withdrawal

Figure 4

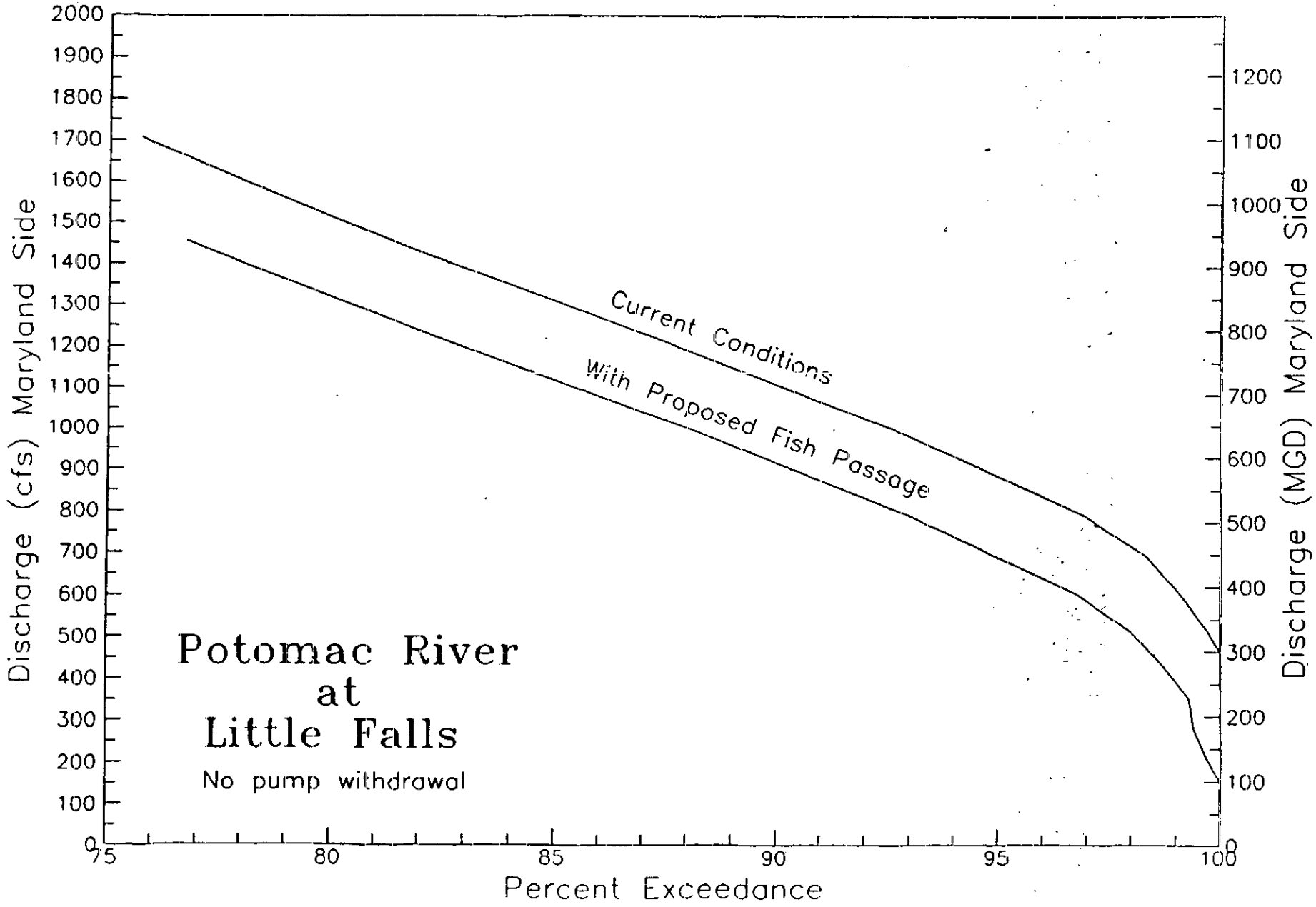

Discharge (cfs) Maryland Side
Discharge (MGD) Maryland Side
Percent Exceedance
Current Conditions
With Proposed Fish Passage
Potomac River
at
Little Falls
No pump withdrawal
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
75
80
85
90
95
100

Figure 5

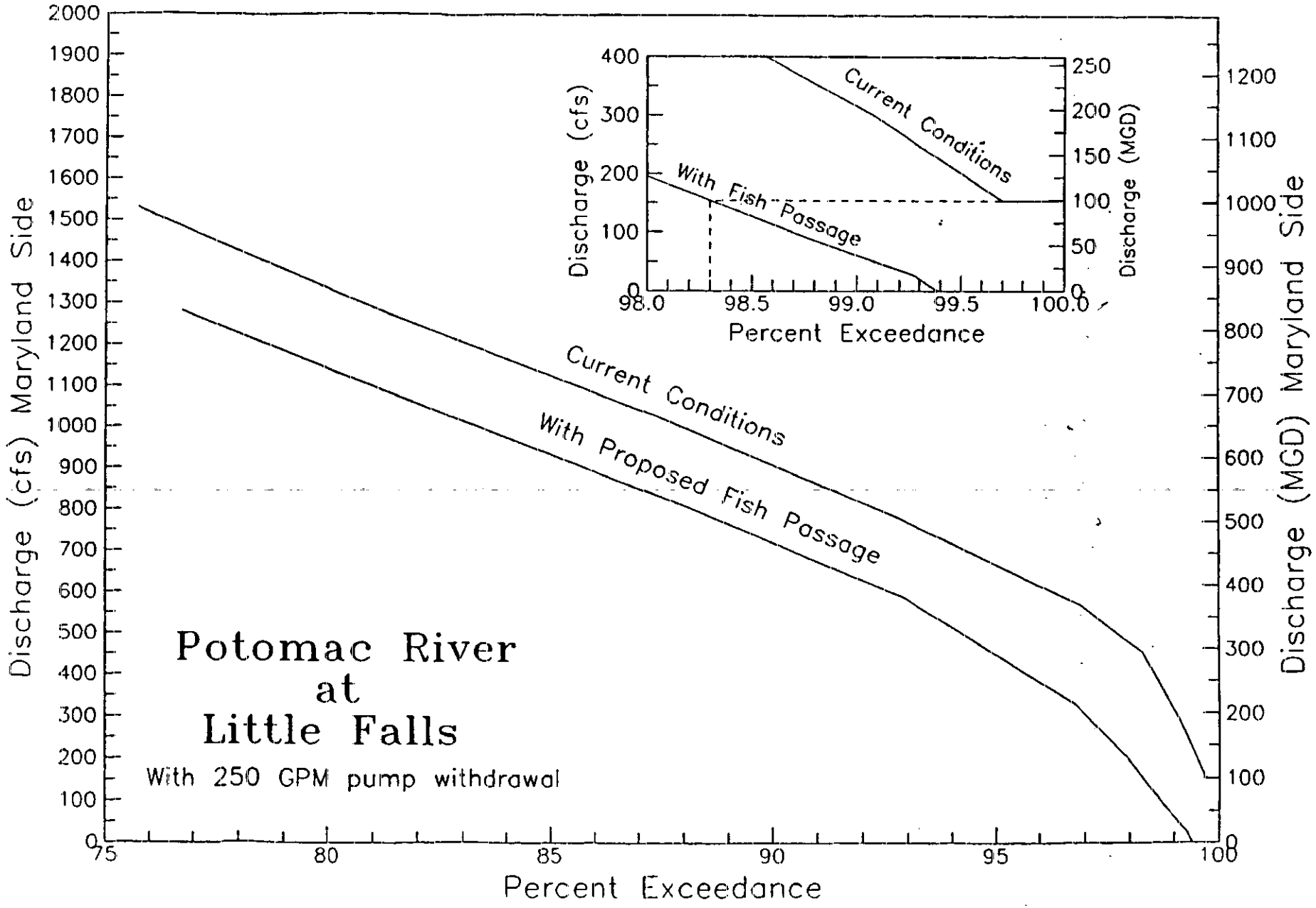

Discharge (cfs) Maryland Side
Discharge (MGD) Maryland Side
Percent Exceedance
Current Conditions
With Proposed Fish Passage
Potomac River
at
Little Falls
With 250 GPM pump withdrawal
Discharge (cfs)
Discharge (MGD)
Current Conditions
With Fish Passage
Percent Exceedance

Figure 6

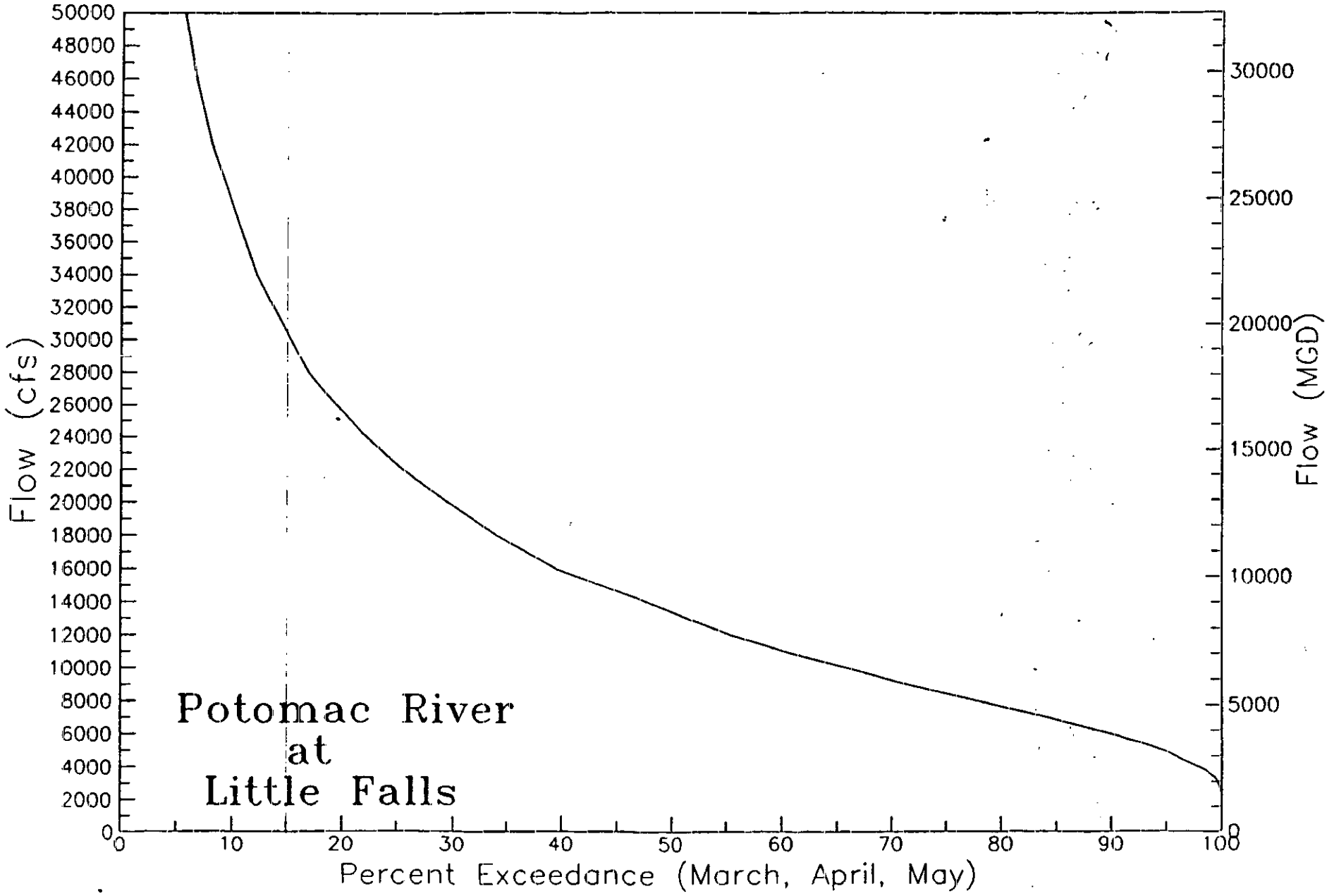

Flow (cfs)
50000
48000
46000
44000
42000
40000
38000
36000
34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Flow (MGD)
30000
25000
20000
15000
10000
5000
0
0
10
20
30
40
50
60
70
80
90
100
Percent Exceedance (March, April, May)
Potomac River
at
Little Falls

Figure 7